Phytotaxa 202 (2): 094–102
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.202.2.2

Morphological and molecular evidence for a new species of *Russula* (Russulaceae) from southern China

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Abstract

Russula subrutilans sp. nov., a new species of *Russula* is described from southern China. It is unique for having buff pink to light congo-pink pileus, distant ventricose to subventricose lamellae with rare lamellulae, globose to broadly ellipsoid spores with bluntly conical warts forming a partial reticulum, and narrowly clavate to clavate cheilocystidia and pleurocystidia with variable tips. Phylogenetic relationships among the new species and other closely related species in the genus are inferred based on the internal transcribed spacer (ITS) region.

Keywords: Basidiomycetes, phylogeny, Russulales & taxonomy

Introduction

Russula Pers. (Russulaceae, Russulales, Basidiomycota), erected by Persoon in 1796, is a widely distributed genus in the world (Persoon 1796; Lebel & Tonkin 2007). Species within *Russula* are well known by the combination of their conspicuous and fleshy fruit bodies, colorful fragile pileus, amyloid warty spores, abundant sphaerocysts in a heteromerous trama that can make the fungi brittle, absence of latex, and the hyphae that lack of clamp connections (Romagnesi 1967, 1985; Singer 1986; Sarnari 1998, 2005). The genus is considered to be of great ecological and economical importance. In forest ecosystems, *Russula* form ectomycorrhizal symbionts with some trees and shrubs of Dipterocarpaceae, Salicaceae, Betulaceae, Pinaceae, Fagaceae, Rosaceae, Fabaceae, Sapotaceae, Nyctaginaceae, Polygonaceae and Tiliaceae (Molina *et al.* 1992; Ying & Zang 1994; Buyck *et al.* 1996). Some species of *Russula* are important edible mushrooms with great commercial values [e.g., *R. rubra* (Fr.) Fr. (1838: 354) and *R. griseocarnosa* Wang *et al.* (2009: 274)] while some in *R. emetica* (Schaeff.) Pers. (1796: 100) group and *R. subnigricans* Hongo (1955: 79) are poisonous (Miller & Buyck 2002; Yang & Piepenbring 2004; Li *et al.* 2010).

The genus *Russula* contains about 750 species and more than 160 of them have been reported from China (Song *et al.* 2007; Kirk *et al.* 2008). However, only 18 species and 3 varieties were originally described from China (Singer 1935; Chiu 1945; Ying 1983; Bi & Li 1986; Ying 1989; Zang & Yuan 1999; Wen & Ying 2001; Song *et al.* 2007; Wang *et al.* 2009; Li *et al.* 2011, 2012, 2013). Because of the lack of systematic study on genus *Russula* in China, many Chinese *Russula* species are misplaced under European or American species names, which probably led to incorrect estimates of the real diversity of *Russula* in China (Li *et al.* 2011, 2012). In this paper, a new species of *Russula* is described from southern China. In order to confirm the phylogenetic uniqueness of *Russula subrutilans*, sequences of its internal transcribed spacer (ITS) rDNA region were generated and compared with sequences from recent molecular phylogenetic studies of the genus *Russula*.

Material & methods

Sampling

Materials were collected by the authors from China during 2012 and 2014. Notes and photographs were taken on macro-morphological features, and specimens were dried using a dörrex dehydrator at 50°C. Specimens were sealed in

 Accepted by Samantha Karunarathna: 13 Jan. 2015; published: 12 Mar. 2015

Morphologically, the new species is also closely related to the two species. However, *R. melliolens* differs from *R. subrutilans* by its larger basidiocarp (pileus up to 10 cm), variable tones of stipe, bigger spores (8.5–11.2 × 8–9.5 μm), crowed and white lamellae discolouring yellowish or ochraceous with age, and clyindrical to fusiform pleurocystidia with long tapering apices (Romagnesi 1967), while *R. umerensis* by its pallid grayish violet pileus, crowed lamellae, conspicuous plage of spores, and fusiform pleurocystidia with the bluntly acuminate (McNabb 1973).

Another species of sect. *melliolentinae, Russula viscida* Kudřna (1928: 56), which described from Czech, is worth noting here. However, the species is not clustered with *R. melliolen* and *R. subrutilans* from phylogenetic analyses. Moreover, *R.viscida* has a bigger basidiocarp (pileus ≥5.5 cm), a red purple tone pileus, crowed lamellae, spores with almost complete reticulum and fusiform cystidia, which make it easily to be distinguished from *R. subrutilans* (Romagnesi 1967).

Furthermore, several species easily to be confused with *R. subrutilans* in field are also compared. *Russula arpalices* Sarnari (1994: 12), described from Italy, is very similar to *R. subrutilans* in field, but the former species can be recognized by its mature pileus often discoloured brownish ochre, slender stipe readily discolored ochraceous to ochre-brown, larger and narrower spores (7.5–9.2 × 5.9–6.8 μm) with warts forming a complete reticulum and distinctive Pelargonium-like odor (Sarnari 2005, Aron & Kibby 2013). *R. zonatula* Ebbesen & Jul. Schäff (1952: 260) is distinguished by its obviously discolored pileus and center often with deep red or purple tone, spore ornamentation isolated, larger pleurocystidia (up to 90 μm), and is associated with beech forest (Romagnesi 1967). *Russula minutula* Velen. (1920: 133) has smaller basidiocarp (≤3.0 cm), hollow stipe, smaller spores (5.7–7.7 × 5–6.7 μm) and basidia (≤35 μm; Romagnesi 1967), while *Russula minutula* var. *minor* Bi (1986: 195) has a smaller basidiomata (≤2.0 cm), hollow stipe, broadly ellipsoid spores with isolated warts or rare ridges, white spore print, smaller cystidia (Bi & Li 1986, Li 2013). *Russula luteotacta* Rea (1922: 469) is distinguished by its slender stipe (up to 7.0 cm), white spores print and spores with warts isolated or joined in rows to form ridge but not forming a partial reticulum, fusoid pleurocystidia with obtuse tip, narrower basidia (≤11μm) and larger pileocysitidia (≥70 μm; Rea1922, Romagnesi 1967) while *Russula betularum* Hora (1960: 456) by its separable cuticle, hollow stipe, hymenial cystidia with the tips various tapering and spore warts isolated or weak lines (Hora 1960, Tschen & Tschen 2005).

Acknowledgements

We are grateful to Dr. Zhijiao Song for improving the manuscript. Our most sincere thanks also give Shichao Liu, Fuyan Liu, Ye Tian and Zhenbo Gao for the language polishing. This study was supported by the National Nonprofit Institute Research Grant of CAF (CAFYBB2014MA003) and the National Natural Science Foundation of China (No. 31070014).

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